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QV381m0 Record/Playback Module

meets the Basic Stamp 2

QV381m0 designed by James Evans Electronics (UK), manufactured by Quadravox Inc. (USA)

The QV381m0 is the latest in a family of speech recording and playback modules designed to complement the existing range of Quadravox speech products.

The QV381m0 module employs a sophisticated micro-controller running a dynamic message allocation algorithm, which in-conjunction with the ISD 5008 device offers the user considerable quality and flexibility. The circuit diagram of the module is shown in **Figure 1**.

The module permits messages to be to be recorded at different sampling rates. The sampling rate selected will depend very much on the desired quality of the sound being reproduced and also the length of the required message/messages. The sampling rate can be varied from message to message as required. After having selected a suitable sampling rate the user can record, playback and erase individual messages on command.

The user can select a unique message number to record in the range 1-255, which can be of any length within the limits of the ISD total storage capacity; e.g. one long message or hundreds of short messages, which fill the device to capacity.

The user has the ability to remotely control the playback volume and also has control over an external amplifier (if required) via the /$\overline{\text{PWR}}$ and AUX pins. For battery powered applications the module can be put into a sleep mode to conserve power.

QV381m0 control options

The Record/Playback module may be controlled by a PC, via the QV430P Programming Cradle which is also supplied by Quadravox.

The QV430P programming cradle is a convenient and *deluxe* means of making the necessary connections to program and test Quadravox ISD-based playback modules. Used in conjunction with the QV381 test program, it enables your PC to configure the module and to record and playback phrases . Additionally an enhanced module configuration program, known as QV300s2, which is currently able to configure several other modules within the Quadravox range, will be available for the QV381m0. The actual recording algorithm is present in every QV3xx

Table I

Command	Description
234 (0xea)	Query module identification
235 (0xeb)	Query current volume level
236 (0xec)	Query current sampling rate
237 (0xed)	Query next available message number
238 (0xee)	Query number of clusters available
239 (0xef)	Query duration of recorded message
240 (0xf0)	Play to speaker
241 (0xf1)	Play to auxiliary output
244 (0xf4)	Record from microphone
245 (0xf5)	Record from auxiliary input
246 (0xf6)	Toggle PWR pin
247 (0xf7)	Toggle AUX pin
249 (0xf9)	Set sampling rate
250 (0xfa)	Sleep mode
251 (0xfb)	Erase message
252 (0xfc)	Set volume
253 (0xfd)	Format device
230 (0xe6)	Stop playback or record

Error /Response Codes	
220 (0xdc)	Invalid number
221 (0xdd)	Message number does not exist
222 (0xde)	Message number to record already exists
223 (0xdf)	No free message numbers
224 (0xe0	ISD device is full; no free clusters
254 (0xfe)	OK – Confirmation

Features

- – Totally dynamic message recording allowing messages to be of variable length.
- – Intelligent message allocation recording and playback algorithm
- – 255 discrete message capacity
- – Individual message erase function
- – Digital volume control — 8 discrete steps
- – User selectable sampling rate 4.0 kHz, 5.3 kHz, 6.4 kHz, 8.0 kHz
- – Serial interface — simple RS232 (TXD & RXD)
- – Controlled using simple 2-byte commands
- – User controllable /PWR and AUX outputs to control external amplifiers.
- – Sleep function for very low power applications
- – QV430P programming adapter may be used for pre-programming the prompts
- – free recording software (QV381) from Quadravox website.
- – small size: 58.4 x 45.7 mm

module; the 430P is a 'dumb' adapter for electrical and logical connections.

Alternatively, the module may be connected using a simple TxD/RxD link to your PC's serial port or another microcontroller circuit. The voltage levels have to be limited +5 V/0 V.

This Application Note, however, will explore the connection of the QV381m0 to the extremely popular **Basic Stamp 2 from Parallax**. Here, it is assumed that the BS2 is plugged in on the Board of Education (BoE).

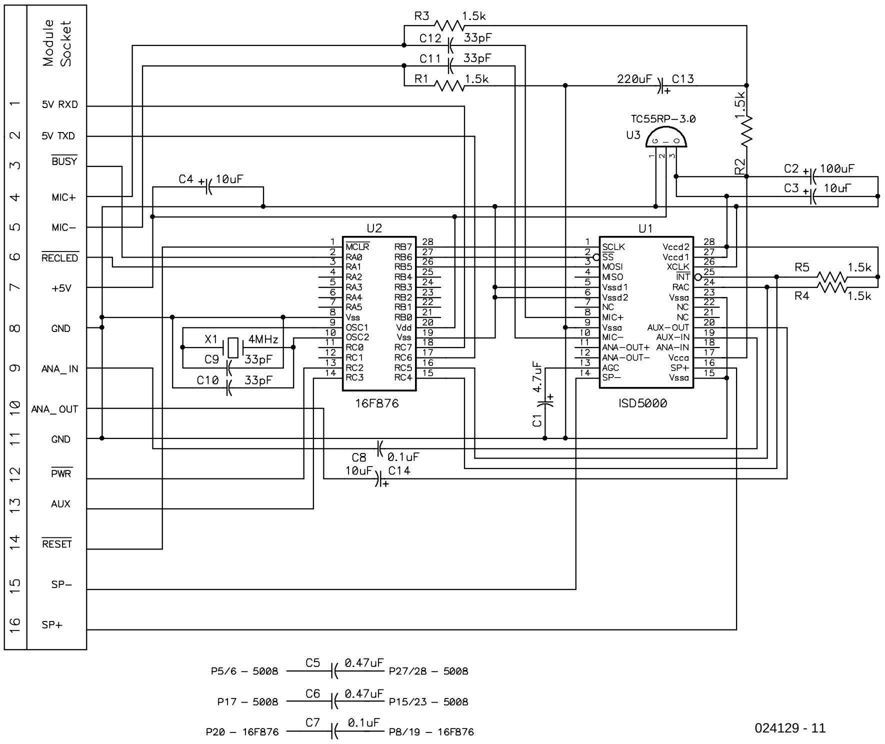


Figure 1. Circuit diagram of the QV381m0 Record/Playback module.

QV381m0 command set

Table 1lists all the command and error/response codes that are required to control the module and correctly interpret its response. All commands sent to the module consist of two bytes. The first byte send will always be one of the above commands. The value of the second byte sent will depend on the command. The function of each of these commands is explained in detail in the *QV381m0 Users Manual* which is available for downloading from the Quadravox website. It is assumed that a PC (Personal Computer) is being used to control the module.

If an LED is connected to the LED output of the module it will illuminate for the duration that a task is being carried out. The BUSY line on the module will also go low for over the duration that it is carrying out a task and is unable to respond to serial commands.

For commands of very short duration the LED will only 'flicker'.

Interfacing the Basic Stamp 2 to the QV381m0

The QV381m0 is extremely well suited to stand-alone operation in conjunction with a microcontroller. A great candidate for this function is the popular Basic Stamp 2 (BS2) which may be programmed in… yes, BASIC! Here, the wonderful **Board if Education** (BoE) is used to host the BS2. The BoE is available from Parallax Inc. and its distributors (UK: Milford Instruments). It was prominently featured in 'BASIC Stamp Pro-

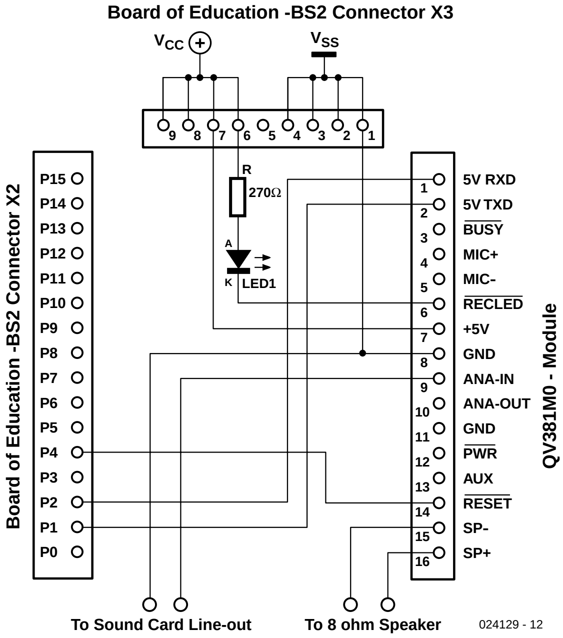


Figure 2. Basic Stamp Board of Education BS2 connection details to QV381m0 Record/Playback module.

gramming Course (1-8)' published in the September 1999 through April 2000 issues of *Elektor Electronics*. The BS2 was described in 'More Power and Performance from the BASIC Stamp', see *Elektor Electronics* July/August 2001.

As seen in the schematic diagram in **Figure 2**, only a simple interface is required to control the module. The Basic Stamp 2 test program (discussed further on) can be easily modified or expanded and provides an easy starting point for user experimentation.

All connections to the QV381m0 module are brought out to its 16-pin edge connector. These are marked on its PCB. and when compared with the schematic, their physical position relates directly to the module.

The schematic diagram assumes that the Basic Stamp 2 is used in conjunction with the Board of Education and its associated hardware (breadboard area and regulated 5V supply).

The QV381m0 can be directly plugged into the breadboard area on the BoE.

The interface between the BS2 and the module makes use of three port pins on the Basic Stamp 2. These are configured for use as the serial transmit and receive lines to communicate with the module and a reset line to initialise its microcontroller.

Connector X3 on the Board of Education can provide the power and ground connections for the module, as shown in the schematic diagram.

Only an additional LED is required to provide a visual feedback to the user.

The LED will require a current limiting resistor (e.g. 270 ohms as shown in the schematic) and should be connected with its anode to +5V, since it is active low in operation.

In order for the module to record sound, an audio source can be connected to its ANA-IN input or a suitable electret microphone can be connected to its MIC+ and MIC– pins.

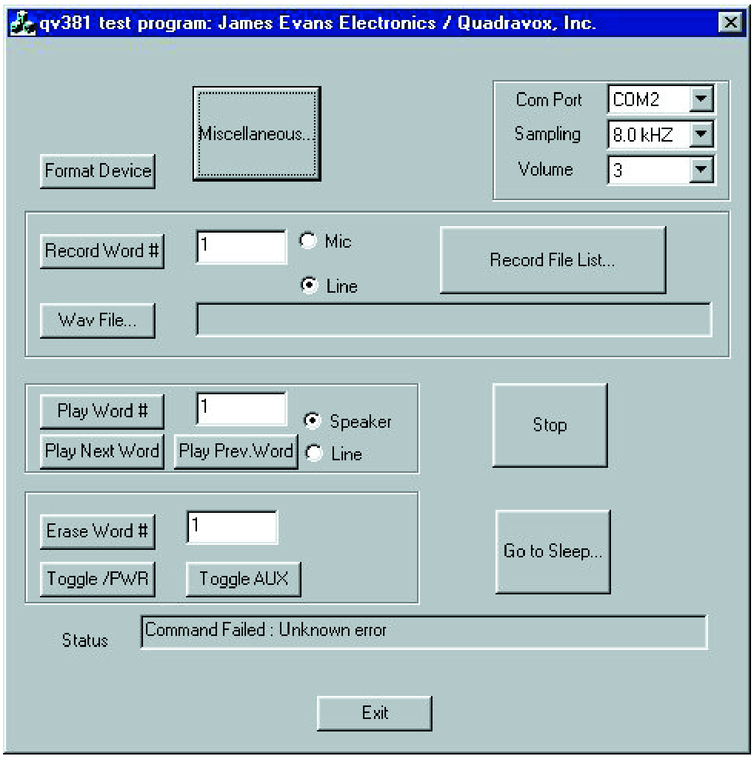
The ANA_IN audio input can be directly connected to the analogue line- out of a sound card of a personal computer with a suitable 3.5-mm stereo jack plug and short length of screened cable, which can easily be constructed.

Since the line-out jack socket from a PC sound card is typically stereo and the QV381m0 module records only a single channel, only on a single signal and ground connection will need to be made to the stereo jack plug. The effect of playing back the sound to a single channel can be compensated for with the software, which comes with the users sound card. Some experimentation may be required to determine the optimum recording level on the module to avoid distortion.

The flying end of the cable will require some sort of termination so that it can be plugged into the breadboard area to make connections to the ANA-IN and GND pins of the module. Individual header pins would be ideal for this purpose.

The test program

The test program shown in **Listing 1** assumes the module will record audio from the ANA-IN input, and will require a change to one


qv381 test program: James Evans Electronics / Quadravox, Inc.

Com Port: COM2
Sampling: 8.0 kHZ
Volume: 3

Record Word #: 1 ○ Mic ● Line

Play Word #: 1 ● Speaker ○ Line

Erase Word #: 1

Status: Command Failed : Unknown error

Figure 3. The QV381m0 comes with this test program called QV381. The frugal main control screen belies the power of this software utility.

instruction in the test program to record from the microphone.

If the user prefers to record audio from a microphone, a sub-miniature electret microphone is ideal (See QV381m0 detailed pin descriptions datasheet).

Connections can easily be made by soldering short lengths of solid tin copper wire to the microphone so that it can be plugged directly into the breadboard area, to make the appropriate connections to the modules MIC+ and MIC– pins (observing the polarity, — one connection of the microphone will go to its metal casing and can usually be seen, otherwise it can be checked for continuity with a multi-meter. This terminal should connect be the MIC– pin on the module).

To make the test program record from the microphone, find the subroutine in the test program called

```
do_record:
```

then change the first line, which reads

```
serout
TRANSMIT_LINE,NBAUD9600,
[QV_RECFRAUX,MessNum]
```

to

```
serout
TRANSMIT_LINE,NBAUD9600,
[QV_RECFRMIC,MessNum]
```

The only change is the command that is sent to the module — sound will now be recorded from the microphone input.

In order to hear the playback, a suitable 8-ohm loud speaker can be connected to the SP+ and SP– pins of the module (See QV381m0 detailed pin descriptions datasheet).

The Basic Stamp 2 test program assumes that sound will be played back to a speaker. Alternatively, sound can be played back to the ANA_OUT connection on the module. The ANA_OUT connection can be directly connected to an external amplifier as required (see QV381m0 detailed pin descriptions datasheet). To make the module playback to the ANA_OUT pin, find the subroutine called

```
do_play:
```

and change the first line, which reads

```
serout TRANSMIT_LINE , NBAUD9600
,
[QVPLAY2SPEAKER , MessNum]
```

to

```
serout TRANSMIT_LINE , NBAUD9600
,
[QVPLAY2AUX , MessNum]
```

The only change has been to the command

Listing 1

```
'QV381M0 Test Program for Basic Stamp-2
'================================================
'Quadravox, Inc (C) 2002 ,J.E.E. (C) 2002

'This Program tests some of the features of the
'QV381M0 Record/Playback Module

'Please see schematic diagram for connection
'details between the QV381M0 and
''Board of Education'
'incorporating the 'Basic Stamp-2

'{$STAMP BS2}

RECEIVE_LINE   con    1
TRANSMIT_LINE  con    2

RESET_LINE  con  4
NBAUD9600   con  84
SMP8KHZ     con  0
SMP6p4KHZ   con  1
SMP5p3KHZ   con  2
SMP4KHZ     con  3

'===========================================
' I/O Definitions

 out2 = 1            'Transmit line high
 output TRANSMIT_LINE
 out4 = 1            'Reset high
 output RESET_LINE
'===========================================
' Aliases for QV381M0 commands
'
QV_QUERY_ID         con  $EA
QV_QUERY_VOLUME     con  $EB
QV_QUERY_SAMPLING   con  $EC
QV_QUERY_MSG_NUM    con  $ED
QV_QUERY_NUM_CLUST  con  $EE
QV_QUERY_DURA       con  $EF
QV_PLAY2SPEAKER     con  $F0
QV_PLAY2AUX         con  $F1
QV_RECFRMIC         con  $F4
QV_RECFRAUX         con  $F5
QV_TOGGPWR          con  $F6
QV_TOGGAUX          con  $F7
QV_SETSMPFR         con  $F9
QV_SLEEPMODE        con  $FA
QV_ERASEMSG         con  $FB
QV_SETVOL           con  $FC
QV_FRMTDEV          con  $FD

QV_OK               con  $FE
QV_INV_NUM          con  $DC
QV_NOMESSNUMEX      con  $DD
QV_MESSNUMEX        con  $DE
QV_NOFREEMESSNUM    con  $DF
QV_NOFREECLUST      con  $E0
QV_STOP             con  $E6

'===========================================
' variables
'
serData     var  byte
serData1    var  byte
MessNum     var  byte
qvVolume    var  byte
qvSampling  var  byte

'===========================================
' Program start
'===========================================


debug  cls
debug "QV381M0 Demonstration ",CR
debug "———————————",CR
```

```
gosub do_reset                ‘Reset the module
gosub do_format               ‘Format the module
for first use
gosub query_msg_num           ‘Return the next
avaialble message number
gosub query_id                ‘Return the module
identification number

qvVolume=0                    ‘0=loudest, 7=qui-
etest
gosub do_set_volume           ‘Set the playback
volume

gosub query_volume            ‘Return the current
volume setting

qvSampling=SMP8KHZ            ‘Set the sampling
rate to 8Khz
gosub do_set_sampling

gosub query_sampling          ‘Read the Sampling
rate setting back

MessNum=1                     ‘Record   message No
1
gosub do_record               ‘Record   from line-
in for 10 seconds

MessNum=1                     ‘Playback message No
1
gosub do_play                 ‘Playback to speaker

MessNum=1
gosub do_erase_mess           ‘Erase Message   No 1



debug “End Of Program”,CR

STOP

endProgram:


‘=================================================
‘Error Conditions
‘=================================================
playNok:
debug “Play Command Refused”,CR
stop

endrecordNok:
debug “Error On End Of Recording”,CR
stop

recordNok:
debug “Recording Refused”,CR
stop

formatNok:
debug “Formatting failed”,CR
stop

query_msg_Nok:
debug “Query Msg Num Failed”,CR
stop

query_id_Nok:
debug “Query Id Failed”,CR
stop

query_sampling_Nok:
debug “Query Sampling Rate Failed”,CR
stop

query_volume_Nok:
debug “Query Volume Failed”,CR
stop

samplingNok :
debug “Sampling Rate Refused”,CR
stop

volumeNok
debug “Volume Not Set”,CR
stop

EraseNok
debug “Message cannot be erased”,CR
stop



‘=================================================
‘Command Subroutines
‘=================================================

query_msg_num:

debug “Query Msg Num “,CR
serout
TRANSMIT_LINE,NBAUD9600,[QV_QUERY_MSG_NUM,0]
serin
RECEIVE_LINE,NBAUD9600,1000,query_msg_Nok,[ser-
Data]
debug “Next Msg: “,HEX2 serData,CR,CR
return

‘=================================================
query_id:

debug “Query ID “,CR
serout TRANSMIT_LINE,NBAUD9600,[QV_QUERY_ID,0]
serin
RECEIVE_LINE,NBAUD9600,1000,query_id_Nok,[ser-
Data,serData1]
debug “Module Series: “, DEC2 serData ,”     Ver-
sion: “, DEC2 serData1, CR,CR
return

‘=================================================
query_sampling:

debug “Query Sampling Rate “,CR
serout TRANSMIT_LINE,NBAUD9600,[QV_QUERY_SAM-
PLING,0]
serin  RECEIVE_LINE,NBAUD9600,1000,query_sam-
pling_Nok,[serData]
debug  “Sampling Rate: “,DEC2 serData,” Khz”,CR,CR
Return

‘=================================================
query_volume:

debug “Query Volume “,CR
serout TRANSMIT_LINE,NBAUD9600,[QV_QUERY_VOLUME,0]
serin
RECEIVE_LINE,NBAUD9600,1000,query_volume_Nok,[ser-
Data]
debug “Volume: “,HEX2 serData,CR,CR
return

‘=================================================
do_reset:
```

```
OUT4 = 0
pause 1000
out4 = 1
debug “Device Reset”,CR,CR
return

‘=================================================
do_format:

debug “Formatting Device.....”,CR
serout TRANSMIT_LINE,NBAUD9600,[QV_FRMTDEV,0]
serin
RECEIVE_LINE,NBAUD9600,16000,formatNok,[serData]
if serData<>QV_OK then formatNok
debug “Formatting OK....”,CR,CR
return
‘=================================================

do_set_sampling:

debug “Altering Sampling Rate: (0)=8.0KHZ
,(1)=6.4KHz, (2)=5.3Khz ,(3)=4.0Khz “, CR
serout TRANSMIT_LINE,NBAUD9600,[QV_SETSMPFR,qvSam-
pling]
serin RECEIVE_LINE,NBAUD9600,1000,samplingNok
,[serData]
if serData <> QV_OK then samplingNok
debug “Sampling Rate  = “,HEX2 qvSampling,CR,CR
return

‘=================================================

do_record:

serout  TRANSMIT_LINE,NBAUD9600,[QV_RECFRAUX,Mess-
Num] ‘Record from line-in
serin
RECEIVE_LINE,NBAUD9600,1000,recordNok,[serData]
if serData <> QV_OK then recordNok
debug “Start Recording For 10 Seconds”,CR
pause 10000 ‘wait 10 seconds
serout TRANSMIT_LINE,NBAUD9600,[QV_STOP]     ‘end
of record command
serin
RECEIVE_LINE,NBAUD9600,1000,endrecordNok,[serData]
if serData <> QV_OK then endrecordNok
debug “End Of Recording -OK-”,CR,CR
return

‘=================================================
do_play:

serout
TRANSMIT_LINE,NBAUD9600,[QV_PLAY2SPEAKER,MessNum]
‘Play to speaker
serin  RECEIVE_LINE,NBAUD9600,1000,playNok,[ser-
Data]
if serData <> QV_OK then playNok
debug “Playing -OK-  “,CR
serin  RECEIVE_LINE,NBAUD9600,[serData]
debug “Playback Finished”,CR,CR
return

‘=================================================
do_set_volume:

debug “Set Volume (0 to 7) “,”  0=Max, 7=Min”, CR
serout TRANSMIT_LINE,NBAUD9600,[QV_SETVOL,qvVol-
ume]
serin RECEIVE_LINE,NBAUD9600,1000,volumeNok,[ser-
Data]
if serData <> QV_OK then volumeNok
debug “Volume = “ ,HEX2 qvVolume,CR,CR
return


‘=================================================

do_erase_mess

debug”Attempting to erase message”,CR
serout TRANSMIT_LINE,NBAUD9600,[QV_ERASEMSG,Mess-
Num]
serin RECEIVE_LINE,NBAUD9600,1000,EraseNok,[ser-
Data]
if serData <> QV_OK then EraseNok
debug “Erased Message No:= “ ,HEX2 MessNum,”  -OK-
”,CR,CR

‘=================================================
‘=================================================
```

sent to the module. Sound will now be played back to the ANA_OUT pin, the auxiliary audio output.

With the connections as in the schematic diagram, the test-program can be downloaded into the Basic Stamp 2 and the module will record audio as directed by the user.

The test program

1) Resets the module
2) Formats the module
3) Queries the module for the next available message number
4) Queries the module Identification
5) Sets the playback volume
6) Queries the playback volume
7) Sets the Sampling Rate
8) Queries the Sampling Rate
9) Records a message with the No: 1, for 10 seconds
10) Plays back the message No: 1
11) Erases Message No: 1

The test program is structured so that the user can easily experiment by writing their own subroutines or by simply commenting out various segments. The test program only provides a simple starting point, multiple messages can be recorded, played successively, and deleted by calling the subroutines as required. Additional features of the module, not implemented in the test program, are described in the full user manual can be created by using these routines as a framework.

The test program is extensively commented to enable you to add your own extensions and features. The program is available from the Free Downloads section of the *Elektor Electronics* website at www.elektor-electronics.co.uk.

(024129-1)

Product availability

The QV381m0 Record/Playback Module is available from Quadravox Inc., 1701 N. Greenville Ave., Suite 608, Richardson, TX 75081, USA.
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